

POWER PLANT WATER MANAGEMENT -- A DEPARTMENT OF ENERGY/NATIONAL ENERGY TECHNOLOGY LABORATORY R&D INITIATIVE

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Abstract

Electricity production requires a reliable, abundant, and predictable source of water, a resource that is in limited supply in parts of the United States and much of the world. The process of thermoelectric generation from fossil fuels such as coal, oil, and natural gas, as well as nuclear power, is water intensive. Each kilowatt hour generated requires on average approximately 25 gallons of water to produce.¹ It is increasingly apparent that the demand for water by the electric-utility sector will compete with demands from other sectors of the economy. As such, the availability of adequate supplies of water to produce electricity and the impact of power plant operations on water quality are receiving increased attention.

The availability of freshwater is a critical limiting factor in economic development and sustainability and directly impacts electric power supply. A recent study conducted by the Congressional General Accounting Office indicates that 36 states anticipate water shortages in the next ten years under normal water conditions, and 46 states expect water shortages under drought conditions.²

Thermoelectric power plants are second only to agriculture as the largest domestic user of freshwater, accounting for 39% of all freshwater withdrawals in the nation. Based on the most recent U.S. Geological Survey data, fossil-fuel-based electricity generation withdrew more than 97 billion gallons per day of freshwater in 1995, primarily for cooling. Of the total freshwater withdrawn, more than 97% is returned to the source water body.³ The 3% that is not returned is “consumed”, mostly through evaporation from closed-loop, wet-cooling towers into the atmosphere. In 2001, approximately 31% of steam electric generating units^a were equipped with cooling towers, representing approximately 38% of installed generating capacity.⁴

In response to the linkage between water and energy, the Department of Energy’s National Energy Technology Laboratory (DOE/NETL) is carrying out a research and

^a Steam-electric generating units include regulated and unregulated fossil-fueled and combustible renewable-fired plants of 100 MW capacity and greater, representing a total nameplate capacity of 478 gigawatts.

development (R&D) effort directed at developing technologies and approaches to better manage how power plants and other energy-related projects use and affect freshwater resources. The research encompasses laboratory and bench-scale activities through pilot- and full-scale demonstrations and is built upon partnership and collaboration with industry, academia, and other government and non-government organizations.

Power plants will likely be challenged in the not too distant future with more stringent restrictions on water use and water quality, placing further pressures on our electricity infrastructure. To help ensure that the nation continues to have a supply of clean, reliable, and affordable electricity, an R&D effort will be needed to address emerging power plant and water issues.

Innovations for Existing Plants Program

DOE/NETL is carrying out a comprehensive, integrated R&D program under its Innovations for Existing Plants (IEP) program. The overall goal of the IEP program is to develop advanced technology and knowledge products that enhance the environmental performance of the existing fleet of coal-fired power plants. The program encompasses research focused on advanced, low-cost environmental control systems and ancillary science and technologies that can help the existing fleet of coal-based power plants meet current and future environmental requirements. The program also provides high-quality scientific information on present and emerging environmental issues for use in regulatory and policy decision making.

The IEP portfolio encompasses R&D related to the control of mercury, nitrogen oxide, particulate matter, and acid gas emissions from power plants, as well as research in the area of ambient air quality, atmospheric chemistry, and coal by-products. In response to the growing tension between freshwater availability and quality and electricity production, the IEP program has been broadened to include research directed at power plant related water management issues.

Power Plant Water Management R&D Initiative

The goal of the IEP program's water R&D activities is to reduce the overall impact of power plant operations in terms of both water use and water quality. This new research effort was initiated in recognition of the relationship between power plants and water. Several water projects supported by the IEP program will be discussed.

References

¹ Mulik, P.; Adams, J.; Hoffmann, J.; Poe-Henderson, B.; Blair, D.; Shuster, E.; Ramezan, M. ***Water Energy R&D Scoping Program, Final Report***, Prepared for the U.S. Department of Energy National Energy Technology Laboratory, September 2003.

² United States General Accounting Office. *Freshwater Supply, States' Views of How Federal Agencies Could Help Them Meet the Challenges of Expected Shortages*; GAO Report No. GAO-03-514; July 2003.

³ United States Geological Survey, *Estimated Use of Water in the United States in 1995*, U.S. Geological Survey Circular 1200, 1998.

⁴ U.S. Energy Information Agency, *Electric Power Annual 2001*, Table 5.2, <http://www.eia.doe.gov/cneaf/electricity/epa/epat5p2.html>.